are more stabilized energitically. Consequently, the electric resistivity of the specimen, including the preheated at lower temperatures, is smaller than the preheated at higher temperatures.

The specimen including the coke preheated at 1700°C has larger electric resistivity than that preheated at 1300°C in the carbonization process under 950°C, although in the coke grain itself the resistivity of the coke preheated at 1700°C is a little smaller than that of the coke preheated at 1300°C. From this fact, it is probable that the larger resistive structures are formed at the boundaries between coke grains and carbonized pitches in the early stages of carbonization process.

It is improbable in this case that the growth of the crystallites depends on the quantity of the stress induced by the thermal expansion of the coke grains so that the resistivities of the specimens differ from each other.

It is important in industry that the boundaries between the coke grains and the neighboring carbonized pitches have considerable effects on the electric resistivity.

[1] S. Mrozowski, Phys. Rev. **85**, 609 (1952).
[2] R. E. Franklin, Proc. Roy. Soc. (London) **A209**, 196 (1951).

Emissivity for CO_2 at Elevated Pressures*

R. J. Holm,† D. Weber, and S. S. Penner
Guggenheim Jet Propulsion Center and Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California
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TOTAL absorptivity measurements have been carried out at room temperature as a function of partial pressure of CO_2 and of total pressure using nitrogen as pressurizing gas. The results of these investigations are summarized in Fig. 1. Appropriate values at a total pressure of one atmos are compared with emissivity data published by Hottel and Mangelsdorf (1935) in Figs. 2 and 3.

The principal conclusions reached as the result of the present investigations are:

(a) At atmospheric pressure and room temperature, the results of total absorptivity measurements are in reasonably good agreement with the emissivity data of Hottel and Mangelsdorf, the difference increasing somewhat as the optical density is raised.

(b) At pressures in excess of one atmos, the absorptivity (and hence the emissivity) is quite insensitive to changes in total pressure. Thus, between 1.0 and 21 atmos total pressure, the measured values of total absorptivity at fixed optical density are equal within the rather wide limits of error (±15 percent) of the present preliminary investigations. This result can be understood in terms of the ratio of rotational line width to rotational line spacing, which is relatively large for triatomic molecules such as CO_2. There are no apparent reasons why the observed insensitivity of emissivity to total pressure cannot be extrapolated to elevated temperatures. Thus, although the collision half-width of the rotational lines decreases roughly inversely as the square root of the absolute temperature, it also increases linearly with total pressure. Hence the ratio of half-width to line spacing at 3000°K and 20 atmos should be comparable to conditions at 300°K and 11 atmos. Therefore, it appears unlikely that a large error is made if radiant heat transfer calculations involving CO_2 at elevated pressures are based on emissivity data for CO_2 determined at atmospheric pressure. The preceding statement should not be extrapolated indiscriminately to other molecules.[1]

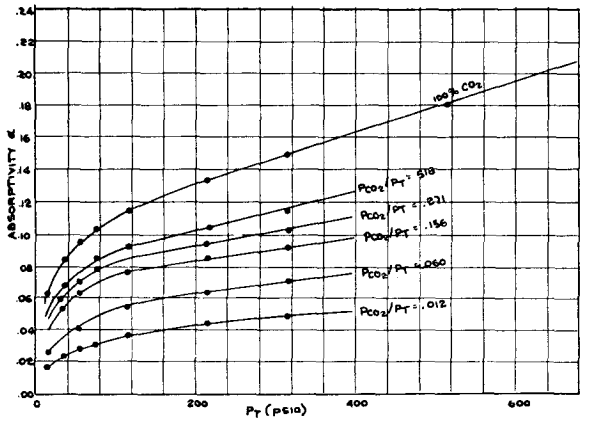

FIG. 1. Absorptivity α as a function of P_T for various fractional pressures of CO_2 at room temperature. The CO_2 was pressurized with nitrogen.

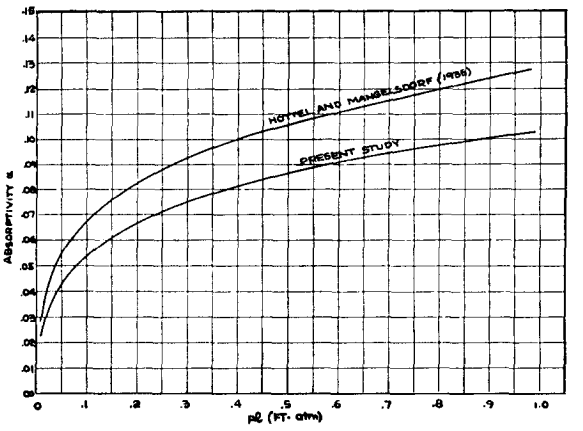

FIG. 2. Comparison of absorptivities for CO_2 at room temperature and atmospheric pressure with emissivities of Hottel and Mangelsdorf ($0 \leqslant p\ell$, ft-atmos $\leqslant 1.0$).

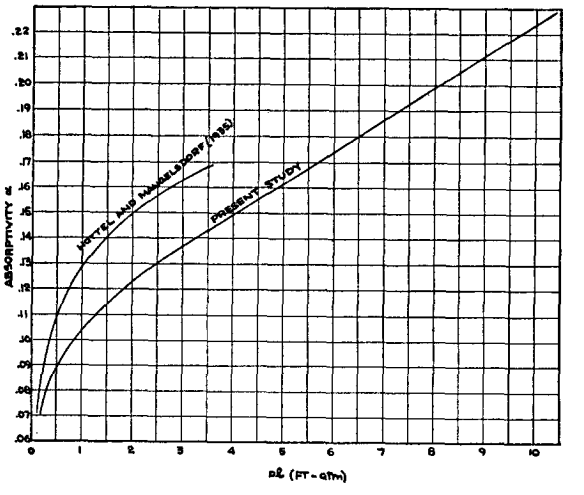

FIG. 3. Comparison of absorptivities for CO_2 at room temperature and atmospheric pressure with emissivities of Hottel and Mangelsdorf ($0 \leqslant p\ell$, ft-atmos $\leqslant 10$).

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[1] For details concerning emissivity calculations on diatomic gases at elevated pressures, see S. S. Penner, J. Appl. Phys. **21**, 685 (1950) or J. Appl. Mech. **18**, 53 (1951).